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The Commissioner of Patents  
WODEN ACT 2606

**Examination Response  
Notice of Entitlement  
Amendment – Amending a Specification**

**Our Ref:** 12627050/GP/DR

**Re:** Australian Patent Application No. 2005252264  
in the name: Memstar Pty. Ltd.

Sir,

In reply to the first official report we hereby seek leave to amend the complete specification. The following are enclosed:

1. First Statement of Proposed Amendments
2. Notice of Entitlement

We are proposing to amend the claims so as to attend to most of the objections taken by the Examiner.

With regard to objection 5, claim 14 generally corresponds to original claim 20 but this has been limited to apparatus which includes a strip solution for removing alcohol from the permeate. It is submitted that this objection is therefore no longer applicable to the amended claims.

With regard to objection 6, the Examiner has asserted that original claims 1 to 31 are not novel and lack an inventive step in view of certain prior art documents. With regard to the limb of this objection based on novelty, it is our strong submission that the amended claims are clearly distinguishable from the prior art documents. In particular, method claim 1 requires processing the beverage by reverse osmosis or nanofiltration for producing a retentate and raw permeate which includes alcohol and then contacting the permeate with a strip solution to remove alcohol prior to returning the dealcoholised permeate to the beverage. There is no document which discloses such a method and it is submitted that claim 1 and claims dependent thereon are clearly distinguishable from the processes described in the cited documents. Similar remarks apply in relation to claim 15 and claims dependent thereon.

The Examiner appears to be placing most emphasis on D3 (WO 92/08783) in this objection. It is apparent, however, that when properly considered the disclosure in D3 is really quite different from that claimed herein. In D3, the only separation of alcohol from the beverage being treated takes place in the reverse osmosis module 34. It is noted that the permeate 38 from the module 34 is not combined back into the beverage. This is in sharp contrast to step (iv) of claim 1 which calls for recombining the retentate with the dealcoholised permeate to form a dealcoholised beverage. Similar remarks apply in relation to the amended apparatus claim, claim 15. Accordingly, it is submitted that these claims as amended can be clearly distinguished from D3.

We also draw the Examiner's attention to claims 2 and 3 which call for heating of the strip solution and/or permeate prior to being contacted with the membrane. As described in the specification, this produces significantly enhanced results. In the case of alcohol reduction in wine, it is not normally possible to heat the wine without taste and aroma components of the wine being lost or damaged. The method of the invention, however, enables the benefits of heating to be obtained because heating takes place on the permeate and/or strip solution rather than the beverage itself. It is again submitted that the invention defined in claims 2 and 3 is not disclosed in the prior art documents.

It is also submitted that the amended claims are novel over D2 (WO 93/22036) and D4 (WO 87/02380).

D2 discloses a generic process using hydrophobic microporous membranes to selectively remove volatile components from liquid mixtures. The main application described is the removal of alcohol from a mixture.

D2 uses a similar principle of evaporative perstraction as are used in the applicant's method and apparatus. However, it is based on direct contact across a membrane of wine and the extracting liquid which may be water or an aqueous solution of a non-volatile solute. A number of examples are given of trials using a PTFE (GoreTex™) membrane. These demonstrate how the flux of volatile components across the membrane is related to the differential vapour pressures of these components across the membrane. It then demonstrates how these fluxes can be controlled by manipulating the component concentration in the extracting or "stripper" liquid.

D2 teaches an especially pertinent point that when wine is dealcoholised with a pure water stripper, there is not only a flux of alcohol from the wine to the stripper ( $1\text{kg/m}^2/\text{hour}$ ), there is also a measurable flow of water in the opposite direction ( $0.2\text{kg/m}^2/\text{hour}$ ). This can be explained by the lower vapour pressure of water on the wine side compared to the stripper side of the membrane as a result of the higher dissolved solids in the wine compared to the water strip. Another way to consider this is that wine has a higher osmotic potential than water so there will be a tendency for water to pass through the membrane from the stripper solution to the wine.

This is a very important phenomenon that is critical for wine dealcoholisation applications and differentiates this approach from that of the applicant. Water passing back into the wine would have a diluting effect and would be considered a water addition which would not be legal in most jurisdictions.

D2 teaches that adding salt to the stripper solution counteracts this by reducing the vapour pressure of water (increasing the osmotic pressure) on the stripper side of the membrane. This is a fundamentally different approach to the applicant's process where the wine is treated with reverse osmosis to remove most of the wine components from the permeate, hence reducing its osmotic pressure and increasing its water vapour pressure prior to contacting the water strip. This substantially overcomes the tendency of water to pass from the strip back into the permeate and hence the wine.

In preferred embodiments of the invention the dealcoholisation portion of the process may be carried out at an elevated temperature (typically 50°C-55°C). This leads to substantially enhanced performance compared to conducting it at ambient temperature (12°C-15°C). Conducting the process at this higher temperature up to the maximum tolerated by the membranes (~70 deg C) increases the rate of diffusion of alcohol vapour across the membranes and so leads to an increase of alcohol transfer rates by almost three times for a given membrane area and flow of strip water. This would not be possible with direct treatment of wine because it would be damaged by the heat and greater loss of volatiles at these higher temperatures. In the present invention, heat has no detrimental effect on the permeate.

Further, by treating wine as in D2, the contactor membranes would suffer from increased and more rapid fouling as a result of phenolic and other materials that are in the wine but not in the permeate. Accordingly, it is submitted that the invention defined in the amended claims is clearly distinguishable from the disclosures in D2 and constitutes a substantial improvement of this process.

D4 discloses a generic semi-permeable membrane which separates a flow of alcoholic beverage from a counterflow of an extraction fluid. Ideally this membrane is selectively permeable to ethanol but not water or other organic components. (Typically these membranes are of the type used for reverse osmosis.) This is not essential however because the extraction fluid itself is either immiscible with water or is of an osmotic pressure comparable with the beverage (wine) being dealcoholised. This is necessary to limit the movement of water across the membrane either into, or out of the wine being treated.

The key to this process is the combination of membrane and extracting fluid to allow the greatest possible flux of ethanol without other desirable wine components passing into the extracting fluid. A secondary extraction process such as distillation removes the alcohol from the extraction fluid which is recycled. Because the process relies on non-porous membranes the actual flux of alcohol is very low. While the data is not easy to interpret, the rate of alcohol removal appears to be very low. It appears that with the various trials, the typical alcohol removal rate from wine was 0.01 litres/m<sup>2</sup>/hr. While the process may allow the selective removal of alcohol, the effective rate is quite impractical for commercial purposes. The system disclosed in D4 clearly does not have the features set out in the amended claims herein.

Further, in preferred embodiments of the present invention where heating is used, for instance as defined in claims 2 and 3, the alcohol removal rate is typically 1 litre/m<sup>2</sup>/hr which is clearly orders of magnitude greater than that achieved in the process of D4.

Claims 4 to 13 define various refinements of the method and it is again submitted that these are not disclosed or suggested in the prior art documents.

With regard to the limb of objection 6 concerning lack of inventive step, the Examiner again appears to be placing most emphasis on document D3. We believe that it is useful to consider this document in more detail in order to properly understand that it does not disclose or suggest the invention and in fact teaches away from the invention herein.

D3 describes a process for reducing the alcohol content of naturally fermented beverages using reverse osmosis. Its various embodiments include several optional pre-filtration treatments of the feed stream to improve the performance of the reverse osmosis stage and prevent desirable beverage components from being removed with the alcohol in the reverse osmosis step. These pre-filtration treatments are described as, first, a micro-filtration (MF) to reduce the colloidal content of the feed stream to the next stage then, second, a nanofiltration (NF) step to reduce the aroma and flavour content of the feed stream to the reverse osmosis (RO) step.

There are three embodiments of this shown in Figures 1-3 and described in the text. The first figure shows all three steps – MF, NF, RO. The second shows NF and RO and the third shows MF and RO. The actual alcohol separation and, supposedly reduction, takes place at this final (RO) stage in all three embodiments.

At a number of points in D3 there are descriptions of the reverse osmosis process that are contrary to the experience over many years of the inventor and other technical staff of the applicant company. For example, in D3 at page 21, lines 14 to 30, it states:

A third step is a reverse osmosis step, wherein ethanol is separated from the remainder of the naturally fermented beverage. In particular the membrane used should be chosen to allow the passage of ethanol through the membrane in the permeate stream, and prevent significant permeation of aroma and flavour compounds through the membrane. Preferably the membrane has the molecular weight cutoff of between 40 and 100. More preferably the membrane has a cutoff of between about 40 and 50. Generally above a molecular weight of 100, aroma and flavour containing compounds may significantly permeate through the membrane. Below about 40 ethanol will not significantly permeate through the membrane. Any reverse osmosis membrane known to those skilled in the art which has the above described permeability characteristics may be used...

The emphasis in this passage is on the relative permeability of ethanol and aroma and flavour compounds. Similarly page 8, lines 11 to 23 state that the reverse osmosis membranes are selectively permeable to ethanol so that ethanol passes into the permeate but aroma and flavour are retained in the retentate. This is true but it is also true that these membranes are *even more permeable to water* so the permeate will always be lower in alcohol concentration than the retentate. To achieve a reduced alcohol concentration in the beverage, it is necessary to separate ethanol from water.

The inventor's understanding of the theory as well as his experience over many years, shows that compounds pass through reverse osmosis membranes preferentially according to how small are their molecules. Water is the smallest of wine components and so passes into the permeate more readily compared to ethanol. Further, the applicant company has used standard reverse osmosis membranes of the permeability characteristics described in D3 for



various processes and numerous trials and, in every case, the concentration of ethanol with regard to water in the permeate *will always be less than in the retentate*.

D3, however, states the opposite at page 22, lines 24 to 33:

In general, the separation results in a stream of retentate which has a higher concentration of flavour and aroma compounds which pass through the previous processing steps than in the feed. Such a retentate has a lower ethanol content than the feed. The permeate is primarily water and ethanol wherein the ethanol concentration is higher than the feed, with little if any, aroma and flavour containing compounds.

According to the process description in D3, the most preferred embodiment has an operating temperature of 2-10°C and operating transmembrane pressure of 25-30 bar. Under these conditions, a preferred permeate flow rate of 20-40 litres/m<sup>2</sup>/hour is claimed. In extensive trials and subsequent processing experience of the applicant company, the permeate flux for wine processed by such membranes under these conditions would be less than 5 litres/m<sup>2</sup>/hour.

As described in D3, the reverse osmosis process would actually result in an *increased* alcohol concentration in the retentate. When this is recombined with the bulk of the beverage as separated earlier in the process, the result would be a lesser volume of product concentrated with regard to flavour and aroma and with a slightly *higher* concentration of ethanol. However there is an optional provision for make up water from the water source 42 to be added to the holding vessel 29 which supplies the feed to the reverse osmosis module 34. This is apparently to restore the original product volume. As the process is described, and according to the explanation above, this is the point at which the actual reduction of alcohol concentration takes place. Without this optional water addition, it is submitted that the process will not work as claimed. With water addition the alcohol concentrate of the beverage will indeed fall, but this is because of *dilution by water addition* rather than by concentration by RO to remove the same volume of liquid. In effect the ethanol is washed out in the permeate of the reverse osmosis step while flavour and aromas are retained.

In this regard the process of D3 is conceptually very similar to that disclosed in US 4,888,189, Gnekow, which involves the addition of water to the wine feed of a reverse osmosis plant to produce low or no alcohol wines. Both of these approaches are inappropriate to the dealcoholisation of standard wines because they involve the addition of water directly to the wine stream. While permitted in the production of many other beverages, water addition to wine is not allowed in most wine producing countries.

It is important to note that this process disclosed in D3 does not involve any treatment and recombination of reverse osmosis permeate, which is fundamental to the applicant's invention. The apparent recombination step is for the optional micro- and nanofiltration pre-treatment stages at which no alcohol adjustment takes place.

In the IPER, the Examiner has asserted that certain claims lack an inventive step in light of D3 when combined with D2 and D4. Whilst it is true that D2 and D4 use a membrane contact process for alcohol removal, it is submitted that they are quite different processes from the invention defined in the amended claims. Further, it is our strong submission that there is no suggestion to use such a contact process in the arrangement disclosed in D3. D3 page 35, lines 23 to 25, states that:

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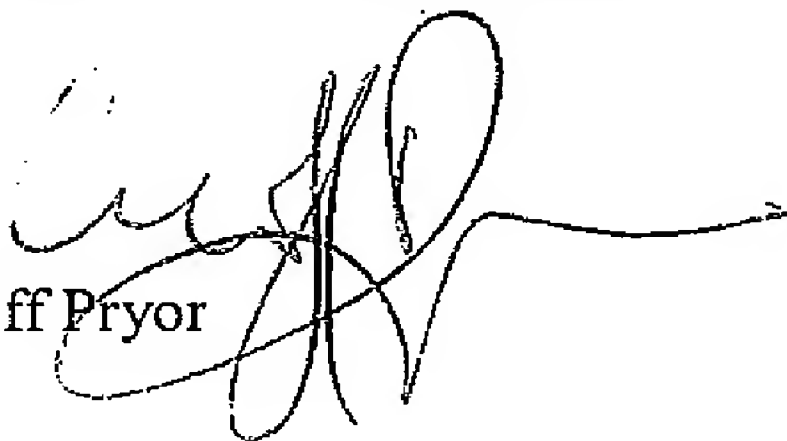
a conduit, 38, removes the reverse osmosis permeate from the reverse osmosis module, 34.

There is no disclosure or suggestion of further treatment of the permeate. Further, even if a contactor were coupled to the conduit 38, there is no disclosure as to what would be done with the permeate once it has been treated in the contactor. There is certainly no disclosure or suggestion that the dealcoholised permeate is combined with the retentate as required by the amended claims herein.

For the reasons set out above, it is strongly submitted that the amended claims are clearly novel and have an inventive step when compared to the prior art documents.

Favourable reconsideration is respectfully requested.

Yours respectfully  
DAVIES COLLISON CAVE

  
Geoff Pryor

Enc.

AUSTRALIA  
PATENTS ACT 1990  
NOTICE OF ENTITLEMENT  
[CONVENTION AND NON-CONVENTION APPLICATIONS]

Name of (1) MEMSTAR PTY. LTD. (formerly Wine Network Technology Pty. Ltd.)  
Applicant: (2) .....  
  
Address of (1) 29 Dalgety Street, Oakleigh 3166, Victoria, Australia  
Applicant: (2) .....

Serial No. of Australian Application, if known: 2005252264

WE, the above named applicant, state the following:

1. The person nominated for the grant of the patent has entitlement from the actual inventor by assignment from the inventor to the applicant.
2. The person nominated for the grant of the patent is the applicant of the basic application listed on the patent request form.

DATED this 20th day of December, 2007



\_\_\_\_\_  
(A member of the firm of DAVIES COLLISON CAVE  
for and on behalf of the Applicant)

- N.B. 1. \*For corporations only  
2. Special forms required for Divisionals, Patents of Addition, Provisionals, Applications requiring microorganism deposits and cases where earlier filed applications to be disregarded for Convention purposes.

DAVIES COLLISON CAVE

AUSTRALIAN PATENT APPLICATION NO. 2005252264

MEMSTAR PTY. LTD.

FIRST STATEMENT OF PROPOSED AMENDMENTS

1. Delete pages 4, 5 and 7 at present on file and replace with new pages 4, 5 and 7 forwarded herewith, together with marked-up pages.
2. Delete the claims at present on file and replace with new claims forwarded herewith, together with marked-up pages.

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In practice this results in high levels of extraction of other desirable volatile components from the wine, such as flavours, esters and sulphur dioxide. One approach suggested by the developers of this technique was to "spike" the strip solution with these compounds so that no concentration gradient for the compound exists. This is complex and expensive and renders the by-product less useful. Other efforts to limit the extraction of desirable volatiles by recycling some of the strip stream reduce the efficiency of the process. Efficiency is also compromised by the presence of relatively large concentrations of CO<sub>2</sub> and other gases in wine. These cannot easily be removed without also removing desirable volatiles.

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The object of the present invention is to provide an improved technique of dealcoholisation of beverages which minimises extraction of desirable volatile components from the beverage.

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According to one aspect of the invention there is provided a method of reducing the alcohol content of an alcohol containing beverage including the steps of:

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(i) processing the beverage by reverse osmosis or nanofiltration for producing a retentate and a raw permeate which includes alcohol;

(ii) contacting a first side of an hydrophobic microporous membrane with said heated raw permeate;

(iii) contacting a second side of the membrane with a strip solution to extract alcohol therefrom to form a dealcoholised permeate; and

(iv) combining the retentate with the dealcoholised permeate to form a dealcoholised beverage which has an alcohol content lower than that of the beverage.

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Preferably, the strip solution and/or the raw permeate are heated prior to contacting the microporous membrane. It is further preferred that the strip solution and raw permeate are both heated prior to contacting the porous membrane. It will be appreciated that there will be heat conduction between the permeate and strip solution if they are not at the same temperature and therefore it would be possible, although less desirable, to heat one or other of these solutions.

- 5 -

Normally volatile components in wine are destroyed if the wine is heated. In the process of this aspect of the invention, however, the wine itself is not subjected to elevated temperatures but rather the permeate only is subjected to elevated temperatures. Accordingly, superior alcohol strip can be achieved without degradation of the components  
5 in the wine which give it taste and aroma. Stripping at elevated temperatures is much more efficient than stripping at lower temperatures. In the aforementioned article by *Hogan et al.*, the stripping is necessarily carried out at low temperature otherwise the properties of the wine would be seriously downgraded. Accordingly, the process of this aspect of the invention is more efficient than that described in the aforementioned article.

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Preferably, the strip solution and/or the raw permeate has a temperature in the range from about 45°C to 50°C when in contact with said microporous membrane.

Normally the dealcoholised permeate will be at approximately the same  
15 temperature as the strip solution and preferably the method includes the step of cooling the dealcoholised permeate prior to recombining it with the retentate.

In the process of the invention, the beverage itself is not subjected to evaporative perstraction but rather the alcohol rich permeate is subjected to the evaporative  
20 perstraction. The beverage is also not subjected to elevated temperatures.

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The invention also provides apparatus for reducing the alcohol content of an alcohol containing beverage, the apparatus including:

- (i) a first processing stage having a reverse osmosis unit or nanofiltration unit having a retentate outlet and permeate outlet;
- 5 (ii) a pump for supplying beverage to be treated under pressure to the first processing stage whereby retentate is produced at the retentate outlet and raw permeate containing alcohol is produced at the permeate outlet;
- 10 (iii) a second processing stage which includes at least one hydrophobic microporous membrane, the second processing stage having a first inlet for receiving said raw permeate and a second inlet for receiving a strip solution, the membrane being operable to allow alcohol from the raw permeate to pass thereto to the strip solution to thereby remove at least a portion of the alcohol from the raw permeate so as to produce dealcoholised permeate at an outlet of the second processing stage; and
- 15 (iv) means for combining said dealcoholised permeate with said retentate to thereby produce dealcoholised beverage in which the alcoholic content thereof is lower than that of the beverage.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of reducing the alcohol content of an alcohol containing beverage including the steps of:
  - 5 (i) processing the beverage by reverse osmosis or nanofiltration for producing a retentate and a raw permeate which includes alcohol;
  - (ii) contacting a first side of an hydrophobic microporous membrane with said raw permeate;
  - (iii) contacting a second side of the membrane with a strip solution to extract  
10 alcohol therefrom to form a dealcoholised permeate; and
  - (iv) combining the retentate with the dealcoholised permeate to form a dealcoholised beverage which has an alcohol content lower than that of the beverage.
2. A method as claimed in claim 1 wherein the strip solution and/or the raw permeate  
15 is or are heated to a temperature which is higher than that of the beverage prior to contacting the strip solution with the membrane.
3. A method as claimed in claim 2 wherein the temperature of the strip solution and/or the raw permeate is or are in the range 45°C to 55°C prior to contacting the membrane.  
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4. A method as claimed in any one of claims 1 to 3 wherein the beverage includes volatile components and wherein the membrane is selected so that substantially all the volatile components remain in said retentate.
- 25 5. A method as claimed in any one of claims 1 to 4 wherein the strip solution is water.
6. A method as claimed in claim 5 wherein carbon dioxide and/or oxygen is removed from the water prior to contracting the membrane.
- 30 7. A method as claimed in claim 5 or 6 wherein carbon dioxide and/or oxygen is removed from the raw permeate prior to contacting the membrane.

8. A method as claimed in any one of claims 1 to 7 wherein the raw permeate has an alcohol content in a predetermined percentage range and after contacting the membrane the dealcoholised permeate has an alcohol content in a range which is substantially lower than  
5 that of the raw permeate.

9. A method as claimed in claim 8 wherein the alcohol content of the dealcoholised permeate is in the range 3% to 6% of volume.

10 10. A method as claimed in claim 8 or 9 wherein the alcohol content of the dealcoholised beverage is 0.5% to 1.5% lower than that of the beverage.

11. A method as claimed in any one of claims 1 to 10 including the steps of storing the beverage in a container and wherein said step of combining the retentate with the  
15 dealcoholised permeate is effected by returning the retentate and dealcoholised permeate to the container.

12. A method as claimed in claim 11 wherein the retentate and dealcoholised permeate are mixed together prior to being returned to the container.  
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13. A method as claimed in claim 11 or 12 wherein the method includes the steps of determining if the alcohol content of the dealcoholised beverage is at or below a predetermined level and continuing to perform steps (i) to (iv) while the alcohol content of the dealcoholised beverage is above said predetermined level.  
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14. A method as claimed in any one of claims 1 to 4 wherein the beverage is wine.

15. Apparatus for reducing the alcohol content of an alcohol containing beverage, the apparatus including:

30 (i) a first processing stage having a reverse osmosis unit or nanofiltration unit having a retentate outlet and permeate outlet;



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(ii) a pump for supplying beverage to be treated under pressure to the first processing stage whereby retentate is produced at the retentate outlet and raw permeate containing alcohol is produced at the permeate outlet;

5 (iii) a second processing stage which includes at least one hydrophobic microporous membrane, the second processing stage having a first inlet for receiving said raw permeate and a second inlet for receiving a strip solution, the membrane being operable to allow alcohol from the raw permeate to pass thereto to the strip solution to thereby remove at least a portion of the alcohol from the raw permeate so as to produce dealcoholised permeate at an outlet of the second processing stage; and

10 (iv) means for combining said dealcoholised permeate with said retentate to thereby produce dealcoholised beverage in which the alcoholic content thereof is lower than that of the beverage.

16. Apparatus as claimed in claim 15 wherein the second processing stage includes at least one contactor within which said membrane is located and wherein the contactor includes said first and second inlets and first and second outlets, the arrangement being such that the strip solution contacts the membrane on the side opposite to that contacted by the raw permeate.

20 17. Apparatus as claimed in claim 16 including pumping means for pumping the strip solution through said at least one contactor.

18. Apparatus as claimed in claim 17 including heating means for heating the strip solution prior to passing through said at least one contactor.

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19. Apparatus as claimed in claim 17 or 18 including a heat exchanger for heating the raw permeate prior to passing through said at least one contactor.

20. Apparatus as claimed in claim 18 wherein the heat exchanger is arranged to extract  
30 heat from dealcoholised beverage.

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21. Apparatus as claimed in any one of claims 16 to 20 including degassing means for degassing the strip solution prior to passing through said at least one contactor.
22. Apparatus as claimed in claim 21 wherein the degassing means removes oxygen  
5 and/or carbon dioxide from the strip solution.
23. Apparatus as claimed in any one of claims 16 to 22 including second degassing means for degassing the raw permeate prior to passing through said at least one contactor.
- 10 24. Apparatus as claimed in claim 23 wherein the second degassing means removes oxygen and/or carbon dioxide from the raw permeate.
25. Apparatus as claimed in any one of claims 15 to 24 including a container for storing said alcohol containing beverage and wherein the apparatus includes a return line  
15 for returning the retentate and dealcoholised permeate to the container.
26. Dealcoholised beverage when made by the method claimed in any one of claims 1 to 14 or the apparatus of any one of claims 15 to 25.
- 20 27. A method of reducing the alcohol content of an alcohol containing beverage or apparatus for reducing the alcohol content of an alcohol containing beverage substantially as hereinbefore described with reference to the accompanying drawings.